KEITHLEY

Model 2400 Series SourceMeter User's Manual Addendum

Introduction

This addendum to the 2400 Series SourceMeter User's Manual is being provided in order to supply you with the latest information in the least possible time. Please read this information and incorporate it into the manual before using the instrument.

Firmware revision level

The information in this addendum pertains to SourceMeters with main firmware revision level C18 or later. The main firmware revision level is displayed as part of the power-up cycle, and you can also display the main firmware revision level with the main MENU GENERAL/SERIAL# selection.

Overview

This addendum provides information on NPLC caching, which caches A/D reference and zero values to speed up source memory sweeps, typically by a factor of three. See Source memory sweep on page 10-5 and Performing a source memory sweep on page 10-18 in Section 10 of the manual for more information on using source memory sweeps.

This addendum also contains information on changes to trigger model arm layer arm operation. See Section 11 of the manual and Trigger subsystem in Section 18 for details on other aspects of trigger operation.

Front panel NPLC cache operation

Main menu additions

Add the additional selections shown in Table 1 below to the A/D CTRL main menu item shown in Table 1-5 on page 1-20 of the manual. Also add NPLC-CACHE under A/D CTRL in the menu tree of Figure 1-3.

Table 1
Main menu additions for NPLC caching

Main menu item	Description
A/D CTRL	Control auto-zero, line frequency, NPLC caching.
AUTO ZERO	Control auto zero.
DISABLE	Disable auto zero.
ENABLE	Enable auto zero.
ONCE	Force auto zero immediate update.
LINE FREQUENCY	Set line frequency (50 or 60Hz, or AUTO).
NPLC CACHE	Control NPLC caching.
DISABLE	Disable NPLC caching.
ENABLE	Enable NPLC caching.
REFRESH	Update all NPLC values in cache immediately.
RESET	Clear NPLC cache of all NPLC values.
CONTACT CHECK	Set contact check options (24xx-C models only).

Using front panel NPLC caching

NPLC caching speeds up source memory sweeps by caching A/D reference and zero values. When NPLC caching enabled (using the NPLC-CACHE/ENABLE menu selection), the A/D reference and zero values will be saved for up to the 10 most recent voltage, current, and resistance measurement functions settings. Whenever the integration rate is changed via the SPEED key, a recalled user setup (using the SAVESETUP/RESTORE menu selection), or during a source memory recall (either with the SOURCE-MEMORY/RESTORE menu or during a source memory sweep), NPLC caching will occur. If the integration rate is already stored in the cache, the stored reference and zero values are recalled and used. Otherwise, a reference and zero value are acquired and stored in the cache. If there are already 10 NPLC values stored, the oldest one will be overwritten by the newest one.

NOTE *Auto zero should be disabled for maximum source memory sweep speed; otherwise the cache is of little use. With auto zero enabled, new A/D reference and zero values are taken for every reading and saved into the cache, slowing down sweep operation. However, with auto zero disabled, measurements may drift and become erroneous. To minimize drift when using NPLC caching with auto zero disabled, periodically select AUTO-ZERO/ONCE in the A/D-CTRL menu to force an immediate auto zero update.*

Front panel NPLC cache setup procedure

Follow the steps below to enable and use NPLC caching with a source memory sweep:

1. Press the MENU key, select A/D-CTRL, then press ENTER.
2. Select AUTO-ZERO, then press ENTER.
3. Choose DISABLE, then press ENTER to disable auto zero.
4. From the A/D CONTROLS menu, select NPLC-CACHE, then press ENTER.
5. Select ENABLE, then press ENTER to enable NPLC caching.
6. Use the EXIT key to back out of the main menu structure.
7. Set up the source memory parameters, and run the source memory sweep. (See Performing a source memory sweep on page 10-18 in Section 10 of the manual.)

Remote NPLC cache operation

NPLC cache commands

Additional commands to support NPLC cache operation are summarized in Table 2. These should be added to the SYSTem subsystem command summary in Table 18-9 on page 18-17 of the manual.

Table 2
SYSTem commands to support NPLC caching

Command	Description
:SYSTem	
:AZERo	Control auto zero and NPLC caching.
[:STATe] <name>	Control auto zero (OFF = disabled; ON = enabled; ONCE = force immediate update of auto zero.)
[:STATe]?	Query auto zero state.
:CACHing	Control NPLC caching.
[:STATe] <b>	Enable (ON or 1) or disable (OFF or 0) NPLC caching.
[:STATe]?	Query NPLC caching state.
:REFResh	Force an immediate update for all NPLC values in cache.
:RESet	Clear the cache of all NPLC values.
:NPLCycles?	Return a list of NPLC values in the cache from oldest to newest.

Using remote NPLC caching

NPLC caching speeds up source memory sweeps by caching A/D reference and zero values. When SYST:AZER:CACH is enabled, the A/D reference and zero values will be saved for up to the 10 most recent [:SENSe[1]]:VOLTage[:DC]:NPLCycles, [:SENSe[1]]:CURRent[:DC]:NPLCycles, or [:SENSe[1]]:RESistance:NPLCycles settings. Whenever the integration rate is changed via an NPLC command, user setup recall (*RCL), or a source memory recall (:SOUR:MEM command or during a source memory sweep), NPLC caching will occur. If the integration rate is already stored in the cache, the stored reference and zero values are recalled and used. Otherwise, a reference and zero value are acquired and stored in the cache. If there are already 10 NPLC values stored, the oldest one will be overwritten by the newest one.

NOTE *Auto zero should be disabled with the :SYST:AZER OFF command for maximum source memory sweep speed; otherwise, the cache is of little use. With auto zero enabled, new A/D reference and zero values are taken for every reading and saved into the cache, slowing down sweep operation. However, with auto zero disabled, measurements may drift and become erroneous. To minimize drift when using NPLC caching with auto zero disabled, periodically send :SYST:AZER ONCE to force an immediate auto zero update.*

Programming examples

Table 3 below gives typical programming examples for NPLC cache commands.

Table 3
NPLC cache command programming examples

Command	Description
:SYST:AZER ONCE	Force immediate update of auto zero.
:SYST:AZER:CACH:RES	Clear NPLC cache.
:SYST:AZER:CACH ON	Enable NPLC caching.

Remote NPLC cache programming procedure

Following these general steps to program and use NPLC caching:

1. Send this command to disable auto zero: SYST:AZER OFF.
2. Enable NPLC caching by sending: SYST:AZER:CACH ON.
3. Set up and run your source memory sweep with the :SOUR:MEM commands along with the various other commands required to program additional operating modes. (See Configure memory sweep starting on page 18-82 as well as other pertinent command descriptions in Section 18 of the manual for details.)

Typical NPLC cache test times

Typically, NPLC caching will decrease source memory sweep times by a factor of three. Table 4 below shows typical averaged times for a test consisting of 10 sweeps of four source memory locations with NPLC values for successive memory locations set to 10, 1, 0.1, and 0.01 respectively.

Table 4
Typical NPLC cache times

NPLC cache conditions	Time
Auto Zero OFF, Caching OFF	5.89s
Auto Zero ON, Caching OFF	5.89s
Auto Zero OFF, Caching ON	2.05s
Auto Zero ON, Caching ON	5.89s
Auto Zero OFF, Caching ON, Cache empty	2.5s

Front panel arm layer events

The changes below apply to the arm layer of trigger mode. Press CONFIG then TRIG, then select ARM-LAYER to program these operating modes.

Arm in events

The /START TEST and START TEST selections in the ARM-IN menu have been replaced with the following:

- ↓STEST: Event detection occurs when the Digital I/O port SOT line is pulsed low.
- ↑STEST: Event detection occurs when the Digital I/O port SOT line is pulsed high.
- ↓↑STEST: Event detection occurs when the Digital I/O port SOT line is pulsed high or low.

For any of the above three Arm-In Events, you can program Arm-In Event detector bypass as follows:

- ONCE: Bypass Arm-In Event detector.
- NEVER: Do not bypass Arm-In Event detector.

Arm out events

The ARM-OUT/EVENTS menu selections have changed as follows:

TRIG-LAYER-EXIT: Select ON (Arm-Out Event when exiting the Trigger Layer) or OFF (no Arm-Out event when exiting the Trigger Layer).

TL-ENTER: Select ON (Arm-Out event when entering the Trigger Layer) or OFF (no Arm-Out event when entering the Trigger Layer).